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TOTAL PAGES INCLUDING COVER SHEET: 19

January 5, 2007

**TO: Commissioner for Patents
USPTO**

LOCATION: Alexandria, Virginia

FAX: 571-273-8300

**RE: S.N. 10/630,658; Group Art Unit:1762; Filed: July 31, 2003
Title: SHIELDED CERAMIC THERMAL COATING
Examiner: K.A. Bareford
Attorney Ref.: D-21320**

Please see attached Appeal Brief (18 pages)

Gerald L. Coon

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICERECEIVED
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JAN 05 2007

Serial No.: 10/630,658

Group Art Unit: 1762

Inventors: Thomas A. Taylor

Filed: July 31, 2003

Title: SHIELDED CERAMIC THERMAL
COATING

Examiner: K. A. Bareford

APPEAL BRIEFCommissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450Certificate of Transmission

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MARGARET HANDY
Signature: Margaret Handy

Sir:

This is a brief in support of an appeal from the decision of the Examiner dated June 28, 2006. A notice of appeal was filed October 6, 2006 together with a one (1) month extension of time.

REAL PARTY IN INTEREST

In accordance with 37 CFR 41.37(c)(1)(i), Praxair S. T. Technology, Inc. is the owner of 100 percent interest in the instant application, which ownership interest is of record in reel No. 014413, frame No. 0407, recorded August 20, 2003.

RELATED APPEALS AND INTERFERENCES

In accordance with 37 CFR 41.37(c)(1)(ii), no other appeals or interferences are known to Appellant, Appellant's legal representative or assignee

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which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

STATUS OF CLAIMS

In accordance with 37 CFR 41.37(c)(1)(iii), the status of all claims is as follows: the rejected claims include claims 1-13, 21 and 22, the withdrawn claims include claims 14-20, and the appealed claims include all of the rejected claims, i.e., 1-13, 21 and 22.

STATUS OF AMENDMENTS

In accordance with 37 CFR 41.37(c)(1)(iv), no amendment was filed subsequent to final rejection.

SUMMARY OF CLAIMED SUBJECT MATTER

In accordance with 37 CFR 41.37(c)(1)(v), the following is a concise explanation of the subject matter defined in each of the independent claims involved in this appeal, i.e., independent claim 1.

Independent claim 1 relates to a method of thermal spraying a material not sensitive to oxidation or nitridation comprising thermal spraying said material from a thermal spray device with a coaxial gas shield having a shield gas flow substantially surrounding the effluent of the thermal spray device to produce a desired microstructure coating on at least a portion of the surface of a substrate having a complex shape and a standoff distance between the surface of the substrate and the exit end of the shielded thermal spray device is at least 20% longer than the standoff distance of a non-shielded thermal spray device and said

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shielded gas flowing thermal spraying producing a microstructure coating similar to a microstructure coating that would be produced using the smaller standoff of the non-shielded thermal spraying device, wherein said method using the shield gas exhibits a temperature effect in which the temperature of the thermal spray effluent is substantially higher close to the thermal spray device and the rate of temperature decline with distance from the thermal spray device is substantially lower than without said shield gas, and in which said temperature effect does not continuously increase with increasing flow rate of the shield gas. See, for example, page 7, lines 11-29, and page 8, lines 4-26, of Appellant's specification.

GROUND OF REJECTION TO BE REVIEWED ON APPEAL

In accordance with 37 CFR 41.37(c)(1)(vi), the grounds of rejection presented for review on appeal are as follows:

whether claims 1-13, 21 and 22 should be rejected under 35 U.S.C. 103(a) as being unpatentable over Zurecki et al. (US 5,738,281) in view of Nowotarski et al. (US 5,486,383) and the admitted state of the prior art; and

whether claims 1-13, 21 and 22 should be rejected under 35 U.S.C. 103(a) as being unpatentable over Zurecki et al. (US 5,738,281) in view of Nowotarski et al. (US 5,486,383) and Taylor et al. "Experience with M Cr Al and thermal barrier coatings produced via inert gas shrouded plasma deposition" (the Taylor article).

ARGUMENT

In accordance with 37 CFR 41.37(c)(1)(vii), the contentions of Appellant with respect to the above grounds for rejection presented for review are set forth below.

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At the outset, Appellant directs the Board's attention to the instant claims which provide a unique method of thermally spraying materials (not sensitive to oxidation or nitridation) by using a gas shield to produce a coating with a desired microstructure using an extended standoff that is at least 20% longer than the standoff of the thermal spray without a gas shield producing the same microstructure. Appellant's claimed invention is particularly useful for controlling the desired microstructure of a coating (not sensitive to oxidation or nitridation) of components with a complex shape using the shielded thermal spray at an extended standoff. The standoff distance between the surface of the substrate and the exit end of a shielded thermal spray device is at least 20% longer than the standoff distance of a non-shielded thermal spray device and the shielded device producing a microstructure coated layer similar or identical to a microstructure coating that would be produced using the smaller standoff of the non-shielded device.

As discussed below with respect to the cited references, gas shields known in the art are used to prevent or reduce the oxidation of reactive materials such as metals during deposition. It would be thought by those skilled in the art to be nonsensical to use such a shield when spraying a material not sensitive to oxidation or nitridation as claimed by Appellant. Appellant has found, however, that there are additional benefits to be gained using such a shield. Appellant has discovered that when using such a coaxial gas shield the temperature of the thermal spray effluent is substantially higher close to the thermal spray device and the rate of temperature decline with distance from the device is substantially lower; i.e., the effluent temperature remains high for a longer distance.

Moreover, Appellant has discovered that the temperature effect is sensitive to the flow rate of the shield gas, and that, surprisingly, it does not continuously increase with increasing flow rate, but that there is an optimum flow rate. This effect would not be expected by one skilled in the art. This is illustrated for a

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particular plasma spray torch using argon shield gas in Example 1 of Appellant's specification.

The higher downstream temperatures obtained with the shielded effluent act to reduce the cooling rate of the particles melted by the plasma torch, and thus allow a denser coating to be deposited at longer standoff than without shielding. The shielding effect when thermal spraying ceramic materials is at least two-fold, maintaining the thermal spray gas temperatures for a longer distance from the nozzle of the thermal spray device thus providing more heat and time for melting the ceramic spray particles and providing more kinetic energy in the gas stream for more distance or time to accelerate the ceramic particles, both effects contributing to better coatings at longer torch to substrate standoff distances. An additional benefit of longer standoff is lower residual stress, since the coating is spread to a thinner layer due to a wider spray pattern at longer standoff.

Surprisingly, Appellant has discovered that by using a gas shield when thermally spraying a high melting material not sensitive to oxidation or nitridation such as ceramic or nonreactive materials such as oxides, but also including nitrides, carbides, and other ceramic and nonreactive materials, that the standoff can be extended without degradation of the microstructure or other properties of the coating. Coatings with a higher density, higher deposition efficiency, higher deposition rate, and more uniform microstructure can be achieved at the extended standoff. These type of coatings can exhibit greater wear resistance, erosion resistance, higher bond strength, and other desirable properties.

These effects are thought to be due to the increased and extended temperature effect due to the shield on the thermal spray effluent. The efficacy of this discovery is illustrated in Example 2 of Appellant's specification using zirconium oxide. It was shown that the microstructures required for thermal barrier coatings could be obtained at significantly longer standoffs with a shield than without. Moreover, at a given standoff, the microstructures were more

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uniform, the coatings denser, and the deposition efficiency higher with a shield than without. The longer standoffs make it possible to coat components such as gas turbine blades and vanes with a more complex shape than was previously possible.

REJECTION UNDER 35 U.S.C. 103(a)

The ground for rejection presented for review here is whether claims 1-13, 21 and 22 should be rejected under 35 U.S.C. 103(a) as being unpatentable over Zurecki et al. (US 5,738,281) in view of Nowotarski et al. (US 5,486,383) and the admitted state of the prior art.

The primary reference, Zurecki et al., discloses the use of a shrouding gas to combine with and protect a turbulent gas jet issuing from an orifice to enable control of a gas jet stream composition downstream from the orifice. The natural aspiration rate of the gas jet is used by Zurecki et al. to determine the flowrate of shrouding gas which is introduced around the gas jet in a soft gas cushion which does not disrupt the flow pattern of the gas jet but instead is entrained into the jet stream to the exclusion of ambient gases in the atmosphere. Zurecki et al. uses the shrouding gas to protect the jet spray from reaction with ambient gases, e.g., reduce the amount of oxygen aspirated into the jet spray, and to protect an applied coating from oxidation by entrained air. See, for example, column 3, lines 46-50 and column 4, lines 15-25.

In the Office Action mailed June 28, 2006, the Examiner has correctly noted that, in a comparison with the claims on appeal, Zurecki et al. does not teach (1) that the resulting effect on microstructure will allow an extended standoff distance for the same microstructure, (2) that the material to be sprayed is not sensitive to oxidation or nitridation, (3) that the substrate has a complex shape, and (4) the specific gas temperature results of using the shroud. These are all embodiments expressly included in independent claim 1.

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In the Office Action mailed June 28, 2006, the Examiner has also correctly noted that, in a comparison with the claims on appeal, Zurecki et al. does not teach (1) that the shield gas is argon, (2) that the material to be sprayed is a ceramic oxide, (3) that the ceramic oxide is zirconia, (4) that multiple layers of coating material are provided, and (5) that the substrate has a complex shape such as turbine blades or vanes. These are all embodiments expressly included in dependent claims 2, 6-8, 10-13, 21 and 22.

The secondary reference, Nowotarski et al., adds nothing to make up for the deficiencies of Zurecki et al. as a primary reference. As noted by the Examiner in the Office Action, Nowotarski et al. discloses the use of a shielding fluid to minimize oxidation, contamination or degradation of coating materials in the turbulent flow stream. See, for example, column 4, lines 20-35.

The additional secondary reference, the admitted state of the prior art, adds nothing to make up for the deficiencies of Zurecki et al. as a primary reference and Nowotarski et al. as a secondary reference. The admitted state of the prior art is that is known to apply ceramic coatings by thermal spraying and it is known to apply thermal spray coatings to complex shapes such as turbine vanes.

Nowhere do the cited references alone or in combination disclose or suggest using a coaxial gas shield in thermal spraying a material not sensitive to oxidation or nitridation, lengthening the standoff distance between the surface of the substrate having a complex shape and the exit end of a shielded thermal spray device (i.e., at least 20% longer than the standoff distance of a non-shielded thermal spray device) without degradation of the microstructure or other properties of the coating on the substrate surface, attaining a temperature effect in which the temperature of the thermal spray effluent is substantially higher close to the thermal spray device and the rate of temperature decline with distance from the thermal spray device is substantially lower than without the shield gas, and that, surprisingly, the temperature effect does not continuously increase with

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increasing flow rate of the shield gas, but that there is an optimum flow rate, thereby permitting the application of thermal spray coatings on complex shapes such as turbine blades and vanes, without degradation of the microstructure or other properties of the coating.

Appellant submits that alleged obviousness of the instantly claimed invention must be predicated on something more than it would have been obvious to try using a coaxial gas shield in thermal spraying a material not sensitive to oxidation or nitridation in order to lengthen the standoff distance without degradation of the microstructure or other properties of a coating and to attain the temperature effect that surprisingly does not continuously increase with increasing flow rate of the shield gas, to arrive at Appellant's claimed thermal spraying method or the possibility that such a particularly defined method for lengthening the standoff and attaining the temperature effect, thereby permitting the application of thermal spray coatings on complex shapes such as turbine blades and vanes, without degradation of the microstructure or other properties of the coating, would have been considered in the future, having been neglected in the past. See Ex parte Argabright et al. 161 USPQ 703. It is submitted that "obvious to try" is not a valid test of patentability, and patentability determinations based on that as a test are contrary to statute. See In re Mercier 515 F2d 1161, 185 USPQ 774; In re Antonie 559 F2d 618, 195 USPQ 6; In re Goodwin et al. 576 F2d 375, 198 USPQ 1; and In re Tomlinson et al. 363 F2d 928, 150 USPQ 623.

Clearly, it is only by hindsight that the Examiner could impute to the disclosures of Zurecki et al., Nowotarski et al. and the admitted state of the prior art, a coaxial gas shield used in thermal spraying a material not sensitive to oxidation or nitridation in order to lengthen the standoff distance without degradation of the microstructure or other properties of a coating and to attain the temperature effect that surprisingly does not continuously increase with increasing flow rate of the shield gas, thereby permitting the application of thermal spray

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coatings on complex shapes such as turbine blades and vanes, without degradation of the microstructure or other properties of the coating, and thereby arrive at the instantly claimed method, and such hindsight obviousness after the invention has been made is not the proper test. See In re Carroll 601 F2d 1184, 202 USPQ 571.

For the reasons set forth above, Appellant submits that the above rejection under 35 U.S.C. 103(a) is improper and should be reversed.

REJECTION UNDER 35 U.S.C. 103(a)

The ground for rejection presented for review here is whether claims 1-13, 21 and 22 should be rejected under 35 U.S.C. 103(a) as being unpatentable over Zurecki et al. (US 5,738,281) in view of Nowotarski et al. (US 5,486,383) and Taylor et al. "Experience with M Cr Al and thermal barrier coatings produced via inert gas shrouded plasma deposition" (the Taylor article).

The primary reference, Zurecki et al., discloses the use of a shrouding gas to combine with and protect a turbulent gas jet issuing from an orifice to enable control of a gas jet stream composition downstream from the orifice. The natural aspiration rate of the gas jet is used by Zurecki et al. to determine the flowrate of shrouding gas which is introduced around the gas jet in a soft gas cushion which does not disrupt the flow pattern of the gas jet but instead is entrained into the jet stream to the exclusion of ambient gases in the atmosphere. Zurecki et al. uses the shrouding gas to protect the jet spray from reaction with ambient gases, e.g., reduce the amount of oxygen aspirated into the jet spray, and to protect an applied coating from oxidation by entrained air. See, for example, column 3, lines 46-50 and column 4, lines 15-25.

In the Office Action mailed June 28, 2006, the Examiner has correctly noted that, in a comparison with the claims on appeal, Zurecki et al. does not teach (1) that the resulting effect on microstructure will allow an extended standoff distance for the same microstructure, (2) that the material to be sprayed is

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not sensitive to oxidation or nitridation, (3) that the substrate has a complex shape, and (4) the specific gas temperature results of using the shroud. These are all embodiments expressly included in independent claim 1.

In the Office Action mailed June 28, 2006, the Examiner has also correctly noted that, in a comparison with the claims on appeal, Zurecki et al. does not teach (1) that the shield gas is argon, (2) that the material to be sprayed is a ceramic oxide, (3) that the ceramic oxide is zirconia, (4) that multiple layers of coating material are provided, and (5) that the substrate has a complex shape such as turbine blades or vanes. These are all embodiments expressly included in dependent claims 2, 6-8, 10-13, 21 and 22.

The secondary reference, Nowotarski et al., adds nothing to make up for the deficiencies of Zurecki et al. as a primary reference. As noted by the Examiner in the Office Action, Nowotarski et al. discloses the use of a shielding fluid to minimize oxidation, contamination or degradation of coating materials in the turbulent flow stream. See, for example, column 4, lines 20-35.

The additional secondary reference, the Taylor article, adds nothing to make up for the deficiencies of Zurecki et al. as a primary reference and Nowotarski et al. as a secondary reference. The Taylor article discloses plasma spray deposition of MCrAlY coatings using argon shrouded torches for corrosion resistance and rub resistance on gas turbine blades, vanes and seal surfaces.

Nowhere do the cited references alone or in combination disclose or suggest using a coaxial gas shield in thermal spraying a material not sensitive to oxidation or nitridation, lengthening the standoff distance between the surface of the substrate having a complex shape and the exit end of a shielded thermal spray device (i.e., at least 20% longer than the standoff distance of a non-shielded thermal spray device) without degradation of the microstructure or other properties of the coating on the substrate surface, attaining a temperature effect in which the temperature of the thermal spray effluent is substantially higher close to

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the thermal spray device and the rate of temperature decline with distance from the thermal spray device is substantially lower than without the shield gas, and that, surprisingly, the temperature effect does not continuously increase with increasing flow rate of the shield gas, but that there is an optimum flow rate, thereby permitting the application of thermal spray coatings on complex shapes such as turbine blades and vanes, without degradation of the microstructure or other properties of the coating.

Appellant submits that alleged obviousness of the instantly claimed invention must be predicated on something more than it would have been obvious to try using a coaxial gas shield in thermal spraying a material not sensitive to oxidation or nitridation in order to lengthen the standoff distance without degradation of the microstructure or other properties of a coating and to attain the temperature effect that surprisingly does not continuously increase with increasing flow rate of the shield gas, to arrive at Appellant's claimed thermal spraying method or the possibility that such a particularly defined method for lengthening the standoff and attaining the temperature effect, thereby permitting the application of thermal spray coatings on complex shapes such as turbine blades and vanes, without degradation of the microstructure or other properties of the coating, would have been considered in the future, having been neglected in the past. See Ex parte Argabright et al., 161 USPQ 703. It is submitted that "obvious to try" is not a valid test of patentability, and patentability determinations based on that as a test are contrary to statute. See In re Mercier 515 F2d 1161, 185 USPQ 774; In re Antonie 559 F2d 618, 195 USPQ 6; In re Goodwin et al. 576 F2d 375, 198 USPQ 1; and In re Tomlinson et al. 363 F2d 928, 150 USPQ 623.

Clearly, it is only by hindsight that the Examiner could impute to the disclosures of Zurecki et al., Nowotarski et al. and the Taylor article, a coaxial gas shield used in thermal spraying a material not sensitive to oxidation or nitridation in order to lengthen the standoff distance without degradation of the

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microstructure or other properties of a coating and to attain the temperature effect that surprisingly does not continuously increase with increasing flow rate of the shield gas, thereby permitting the application of thermal spray coatings on complex shapes such as turbine blades and vanes, without degradation of the microstructure or other properties of the coating, and thereby arrive at the instantly claimed method, and such hindsight obviousness after the invention has been made is not the proper test. See In re Carroll 601 F2d 1184, 202 USPQ 571.

For the reasons set forth above, Appellant submits that the above rejection under 35 U.S.C. 103(a) is improper and should be reversed.

CLAIMS APPENDIX

In accordance with 37 CFR 41.37(c)(1)(viii), the attached Claims Appendix contains a copy of all claims involved in this Appeal.

EVIDENCE APPENDIX

In accordance with 37 CFR 41.37(c)(1)(ix), the attached Evidence Appendix contains a copy of all evidence entered by the Examiner and relied upon by Appellant in this Appeal.


RELATED PROCEEDINGS APPENDIX

In accordance with 37 CFR 41.37(c)(1)(x), the attached Related Proceedings Appendix contains a copy of all decisions rendered by a court or the board involving this Appeal.

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This brief in support of an appeal was due December 6, 2006. Accordingly, submitted herewith is a petition for an extension of time for one (1) month. Also submitted herewith is the required fee for filing a brief in support of an appeal. Please charge fees/surcharge which may be required by this paper, or credit any overpayment, to Deposit Account No. 16-2440.

Respectfully submitted,



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CLAIMS APPENDIXRECEIVED
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Claims on Appeal

1. A method of thermal spraying a material not sensitive to oxidation or nitridation comprising thermal spraying said material from a thermal spray device with a coaxial gas shield having a shield gas flow substantially surrounding the effluent of the thermal spray device to produce a desired microstructure coating on at least a portion of the surface of a substrate having a complex shape and a standoff distance between the surface of the substrate and the exit end of the shielded thermal spray device is at least 20% longer than the standoff distance of a non-shielded thermal spray device and said shielded gas flowing thermal spraying producing a microstructure coating similar to a microstructure coating that would be produced using the smaller standoff of the non-shielded thermal spraying device, wherein said method using the shield gas exhibits a temperature effect in which the temperature of the thermal spray effluent is substantially higher close to the thermal spray device and the rate of temperature decline with distance from the thermal spray device is substantially lower than without said shield gas, and in which said temperature effect does not continuously increase with increasing flow rate of the shield gas.

2. The method of claim 1 wherein the material is a ceramic.

3. The method of claim 1 wherein the standoff distance is at least 50% longer.

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4. The method of claim 1 wherein the coaxial shield gas flow is an essentially turbulent gas flow substantially surrounding the effluent of the thermal spray device.

5. The method of claim 3 wherein the coaxial shield gas flow is an essentially turbulent gas flow substantially surrounding the effluent of the thermal spray device.

6. The method of claim 2 wherein said ceramic material is an oxide.

7. The method of claim 6 wherein said oxide is zirconia or a compound containing zirconia.

8. The method of claim 2 wherein said coating comprises layers of the ceramic material.

9. The method of claims 2 wherein said gas used in the coaxial gas shield is selected from the group consisting of argon, nitrogen, air and mixtures thereof.

10. The method of claim 9 wherein the gas is argon.

11. The method of claim 3 wherein the material is a ceramic material.

12. The method of claim 11 wherein said ceramic is zirconia or a compound containing zirconia.

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13. The method of claim 11 wherein said coating comprises layers of the ceramic material.

14. (withdrawn)

15. (withdrawn)

16. (withdrawn)

17. (withdrawn)

18. (withdrawn)

19. (withdrawn)

20. (withdrawn)

21. The method of claim 2 wherein the ceramic is selected from the group consisting of oxides, nitrides, carbides and other materials not sensitive to oxidation or nitridation.

22. The method of claim 1 wherein the substrate having a complex shape is selected from turbine blades and vanes.

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EVIDENCE APPENDIX

None.

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RELATED PROCEEDINGS APPENDIX

None.